Reg. No. : .....

Name : .....

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B – 3292

Fifth Semester B.Tech. Degree Examination, December 2016
(2013 Scheme)
13.504 : MECHANICS OF MATERIALS (M)

Time : 3 Hours

Max. Marks : 100

PART – A

Each question carries **2** marks.

1. Write the stress tensor at any point on an elastic solid subjected in a uniform hydro-static pressure of magnitude p.

2. The traction at a point on a plane with unit outward normal $\hat{n}$ is $\vec{T}$. What is its value for the plane with outward normal $-\hat{n}$?

3. Write down the Cartesian components of small strain tensor.

4. What is the physical significance of trace of small strain tensor ?

5. What is an axi-symmetric problem ?

6. Write down the equilibrium equations for an axi-symmetric elasticity problem.

7. Write down an equation of strain energy in terms of the stress and strain tensors.

8. What is product moment of inertia ?

9. What is the neutral axis for the case of transverse bending in the x – y plane by applied moment about the z-axis, for a cross section with $I_{yz} \neq 0$.

10. Check whether function given by ψ = Axy is a valid warping function.

(2×10=20 Marks)

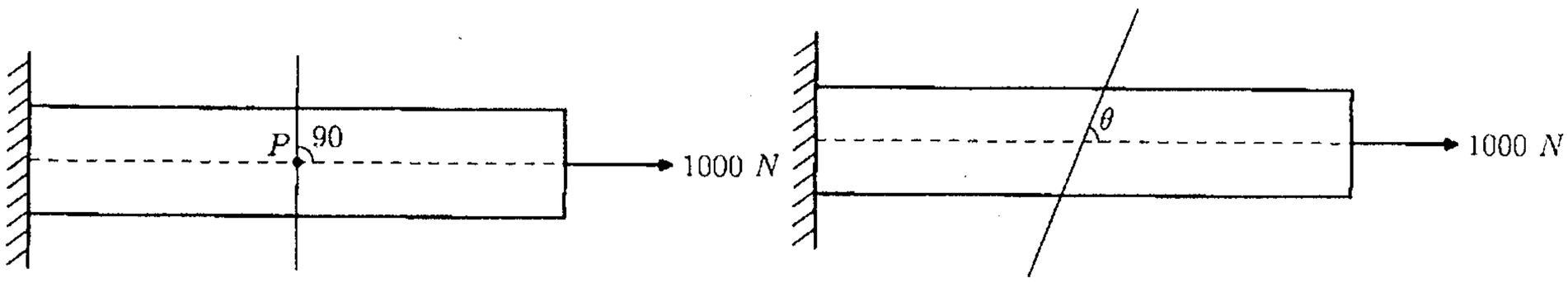
P.T.O.

PART – B

Answer **one** question from **each** Module.

Module – I

11. A rod of uniform cross sectional area of 1 m^2 fixed at one end is subjected to an axial force of 1000 N. For this simple case of loading, resisting force on different sections is uniform distributed. Compute the traction on two planes, one making an angle of 90 and the other making an arbitrary angle θ with the load axis, respectively. Also find out the normal and tangential components of the traction. Plot the Mohr's circle showing the variation between normal and tangential components of traction. **20**



OR

12. a) Derive an equation for the normal stress on a plane passing through a point of a three dimensional elasticity problem in terms of the Cartesian components of stress at that point. **10**

b) Prove that the shear stress on a plane of maximum value of normal stress is zero. **10**

Module – II

13. Starting with the equilibrium equations of two dimensional axi-symmetric condition, derive the general differential equation for the radial displacement of a pressure vessel. Hence obtain a solution for the radial displacement. Also obtain the equations for radial and circumferential strains. **20**

OR

14. a) Write down the strain displacement relations in polar co-ordinate system. **6**

b) Write down the stress strain relations for an axi-symmetric elasticity problem. **6**

c) What are the components of stress in a rotating solid shaft ? **2**

d) Derive a governing differential equation for the radial displacement of a rotating circular disc. **6**

Module – III

15. a) Describe how principle of minimum potential energy is used for solving problems in elastic deformation of solids. **10**

    b) Describe the significance of complementary energy in the case of non-linear elasticity problems. **10**

OR

16. The displacement field of an elastic body is given by $\vec{u} = -yz\,\hat{i} + xz\,\hat{j} + xy\,\hat{k}$. Use the small strain theory to compute the strain energy per unit volume at the point (2, 3, 1). Given that $G = 80 \times 10^6$ kPa and $E = 207 \times 10^6$ GPa. **20**

Module – IV

17. Investigate the warping function $\psi = A(y^3 - 3x^2y)$. Identify the cross section of the prismatic bar for which this function is applicable. Derive expressions for angle of twist and maximum stress. **20**

OR

18. a) What is shear center ? Explain its importance. **5**

    b) Write down the components of stress of a prismatic bar subjected to torsion in terms of stress function. **5**

    c) What is asymmetric bending ? Explain with the help of examples. **5**

    d) Explain Membrane analogy. **5**